



# Test, Measure and Diagnostic Equipment



# Terminal Learning Objective

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- **Provided Test Measurement Diagnostic Equipment (TMDE), appropriate tools, an item of equipment, and the references, diagnose engineer equipment faults per the references. (1341.02.02)**



# Enabling Learning Objective

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- **Provided with various micrometers, an item requiring measurement, measure the item to within plus or minus 0.001 inches in accordance with the appropriate manual.  
(1341.02.02a)**



# Enabling Learning Objective

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- **Provided with a Simplified Test Equipment Internal Combustion Engine- Reprogramable, With the aid of references, diagnose malfunctions in the items of engineer equipment provided. (1341.02.02b)**



# Enabling Learning Objective

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- **Provided with a digital multimeter, with the aid of references, diagnose electrical malfunctions in the items of engineer equipment provided.  
(1341.02.02c)**



# Enabling Learning Objective

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- **Provided with a caterpillar multi-tachometer group, an internal combustion engine, with the aid of references, perform a photo-tach reading to 1200 rpm in accordance with the Caterpillar Tool Guide. (1341.02.02d)**



# Enabling Learning Objective

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- **Provided with an engine pressure gauge group, with the aid of references, an item of engineer equipment, test the engine and hydraulic systems in accordance with the appropriate technical manual. (1341.02.02e)**



# Enabling Learning Objective

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- Provided with a hydraulic flow tester, with the aid of references, an item of engineer equipment, test the flow of a hydraulic pump in accordance with the appropriate technical manual. (1341.02.02f)





# Enabling Learning Objective

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- Provided with a caterpillar hydraulic gauge test set, with the aid of references, an item of engineer equipment, test the hydraulic system in accordance with the appropriate technical manual. (1341.02.02g)



# Enabling Learning Objective

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- Provided with a multi-gauge, with the aid of references, an item of engineer equipment, test the hydraulic system relief valves in accordance with the appropriate technical manual. (1341.02.02h)



# Enabling Learning Objective

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- Provided with an engine valve spring tester, with the aid of references, an item of engineer equipment, test the valve springs to determine if they are within tolerance according to the appropriate technical manual.  
(1341.02.02i)

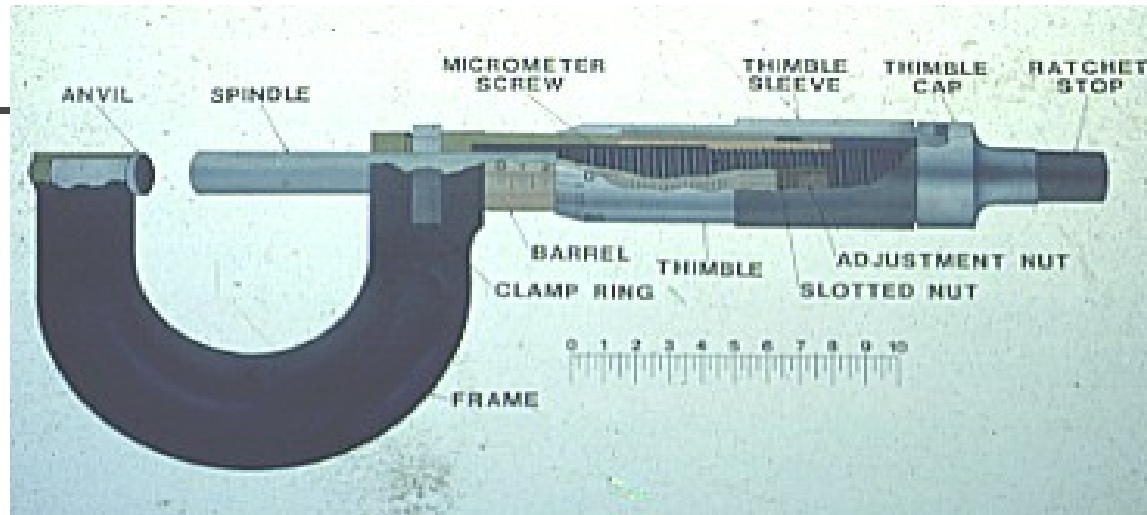


# Student Reading Assignment

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- Shultz Manual Chapter 2, Student outline Prior to class

# Precision Measuring Devices



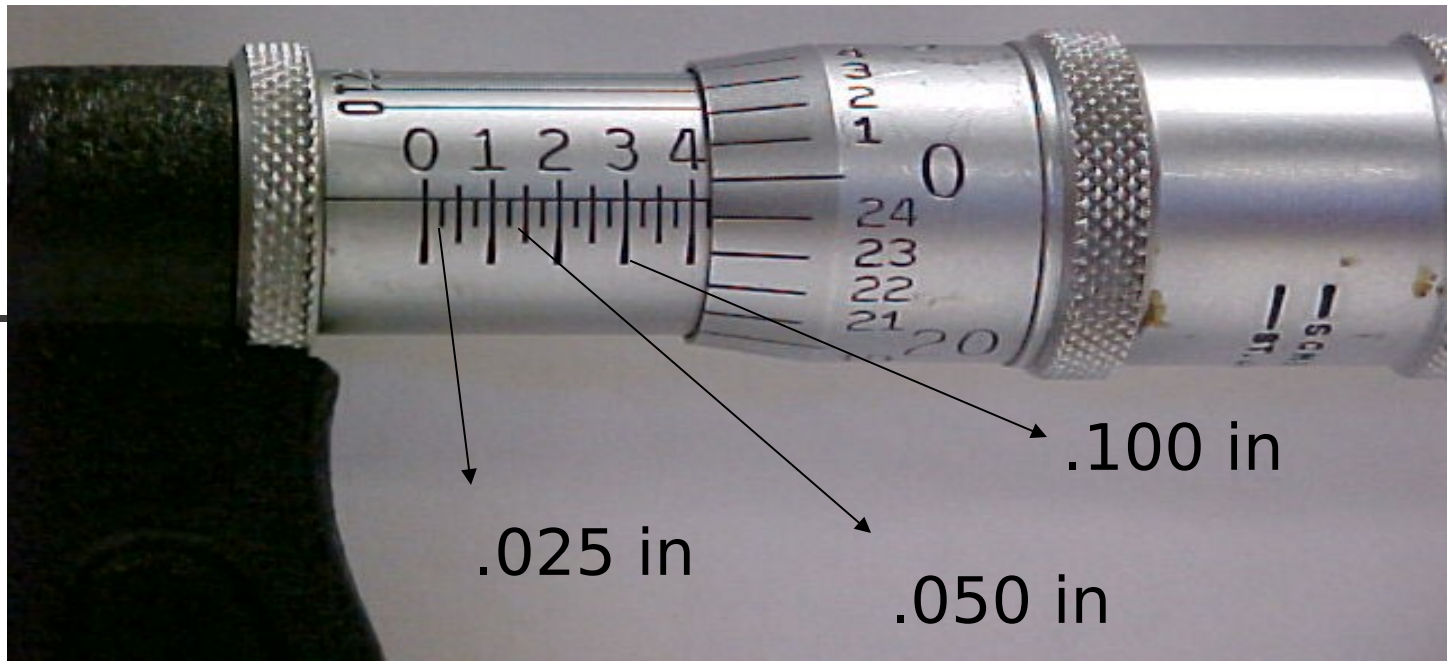
- Micrometers are precision measuring tools, calibrated in .001" and sometimes .0001" increments. Micrometers are sized in increments of 0-1", 1-2", 2-3" and on up.

# Micrometers



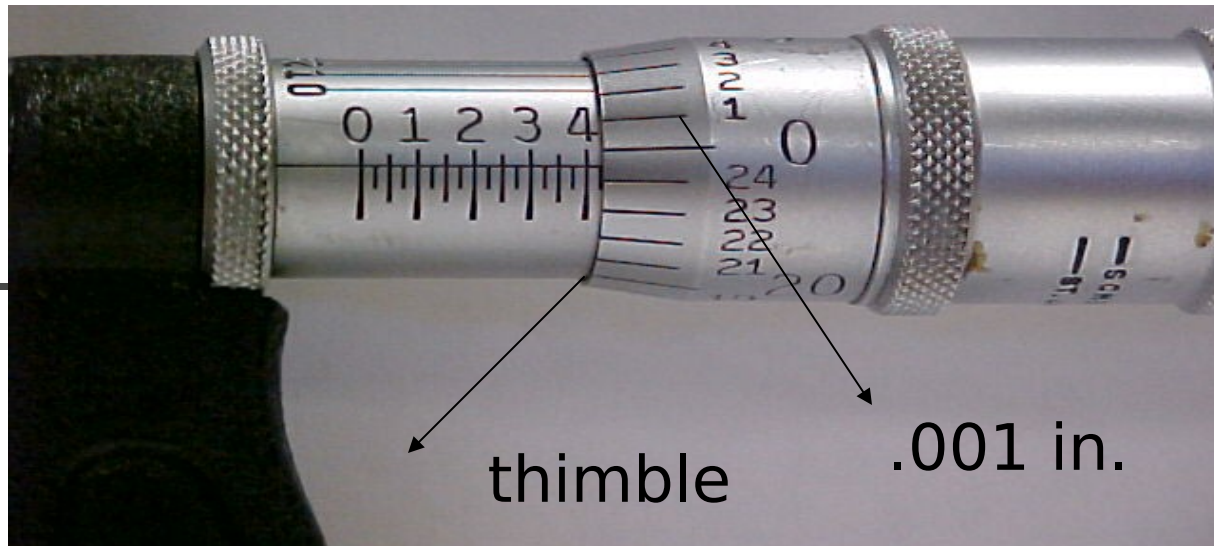
- **All micrometers have an accurately ground screw which rotates on a fixed nut. This opens and closes the distance between the two measuring faces on the end of the anvil and spindle or between the spindle and the object, or between one fixed and one moveable spindle.**





- For faster easier reading, the manufacturers of micrometers have made the vertical lines of three different lengths. Every fourth line is .100 in, Every second, which is the second longest line is .050 in, Each of the short lines represents .025 in





- The thimble is beveled. It is divided into 25 equal parts with each line representing .001 in. Rotating the thimble from one line to the next will move the screw and spindle longitudinally .001 in. For speedier reading, every fifth graduation on the spindle has a longer line and is numbered by 5's, i.e. 5, 10, 15, 20.



- Micrometers that are graduated to the ten-thousandths of an inch are similar to those that are graduated in thousandths of an inch except they have a vernier graduation scale on the sleeve. The vernier scale consist of ten divisions on the sleeve, which occupy the same space as nine divisions on the thimble.

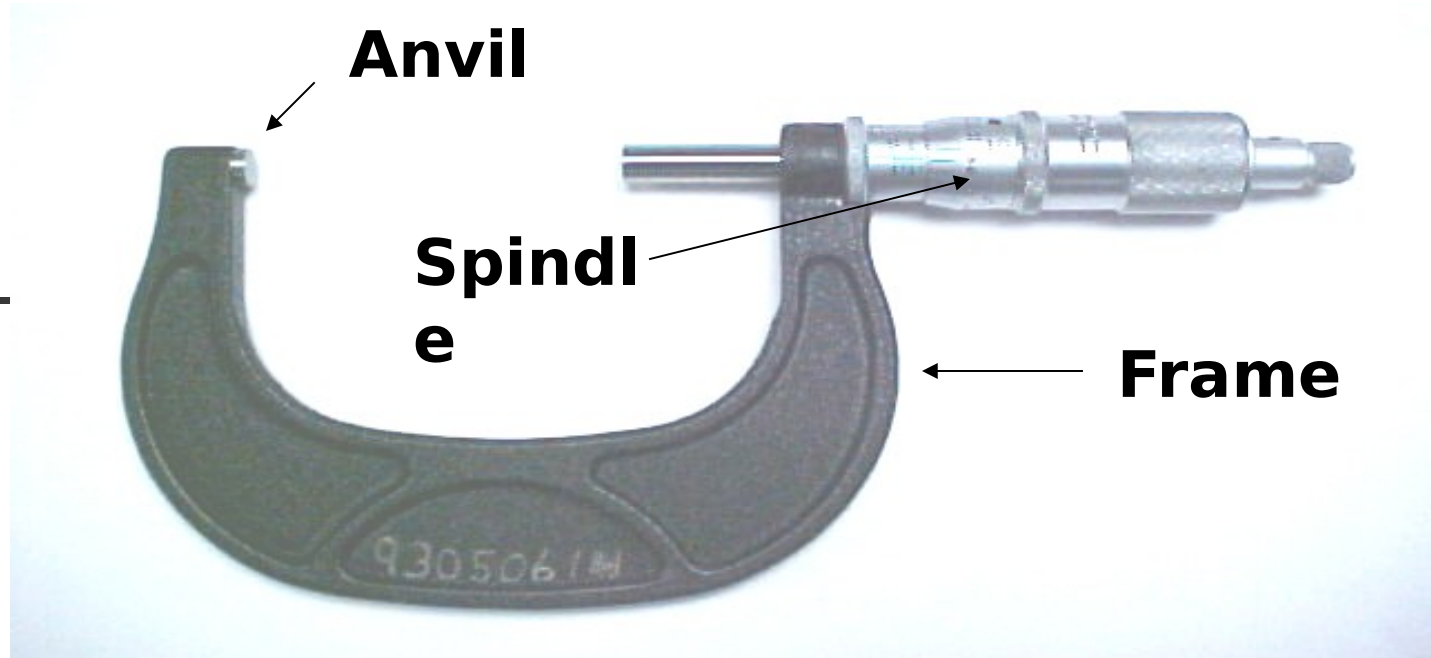


First obtain a .001 in reading.  
 Second check line on vernier scale  
 that coincides with line on thimble- 3

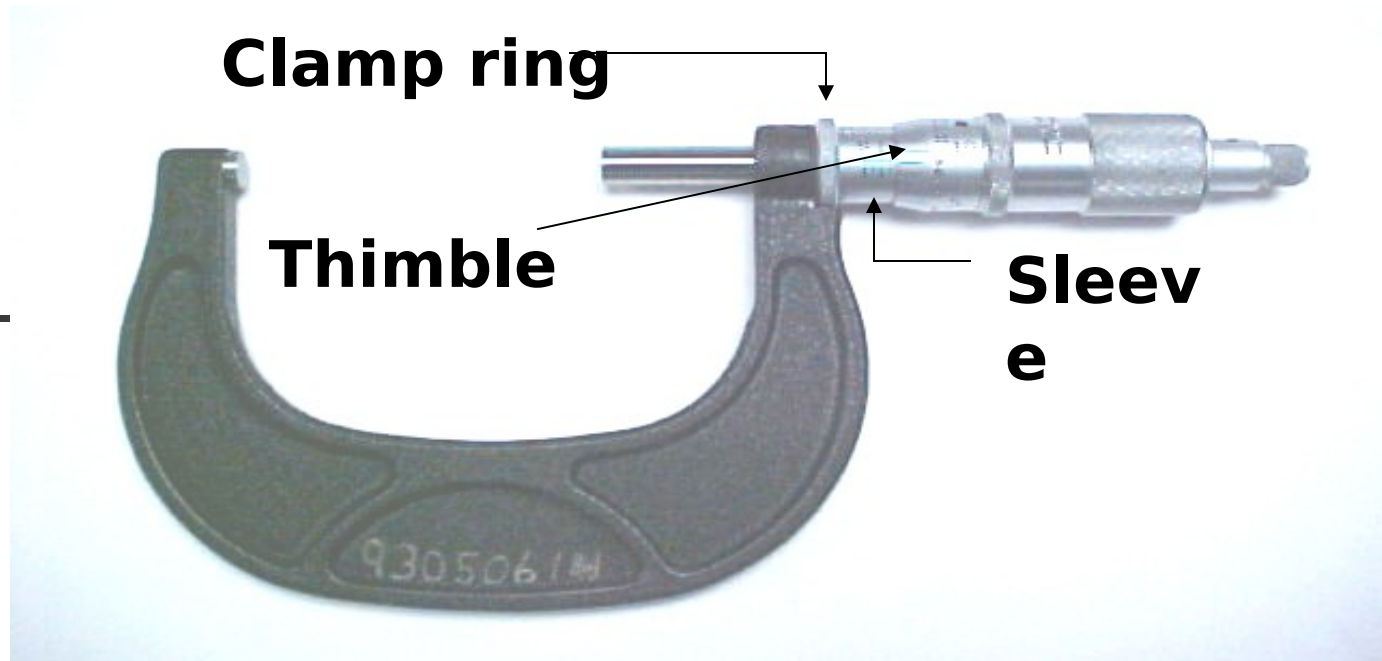
- To read micrometers graduated to .0001 in., you must first obtain a .001 in reading, then check which line on the vernier scale coincides with the line on the thimble. Reading (.1673)



- Outside micrometers are used for outer surface measurements requiring precision accuracy such as camshaft lobes and crankshaft journals.
- The following components make up a micrometer:



- Frame- usually made of steel and of U shape design.
- Anvil- a hardened button either pressed or screwed to the frame.
- Spindle- Advances or retracts to open or close the frame to make precision measurements.



- Clamp ring- locks the spindle so it cannot be moved, and can be removed from the part without disturbing the reading.
- Sleeve- each mark represents .025 in, every fourth numbered line equals .100 in.
- Thimble- Marked in 25 divisions, every mark represents .001 in.



- Ratchet stop- Final clamping is done by turning the ratchet, which slips when proper pressure has been applied.



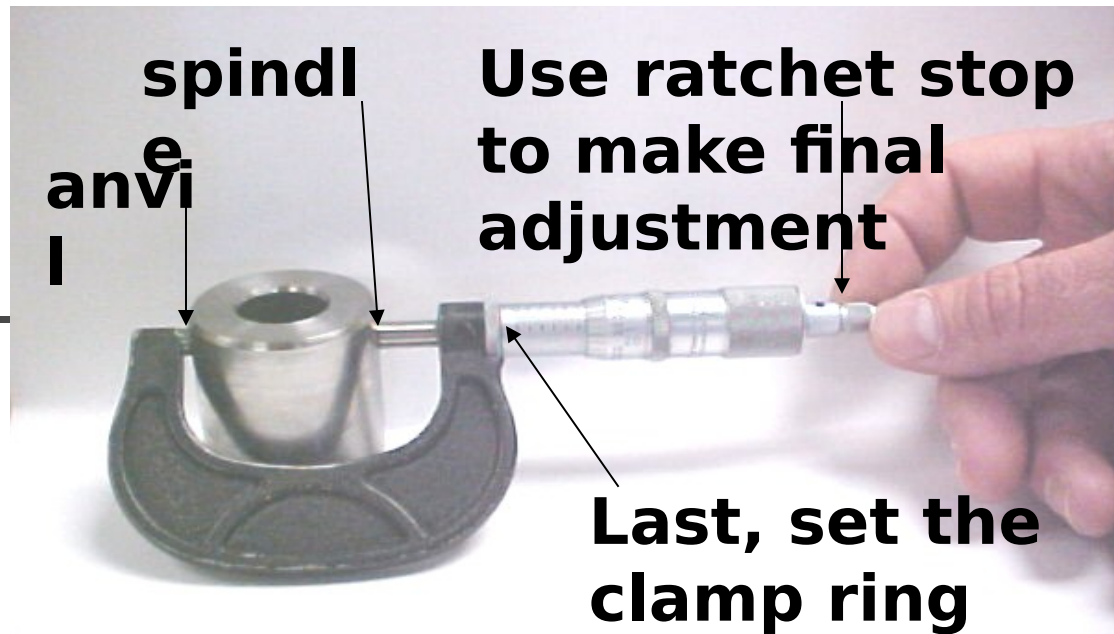
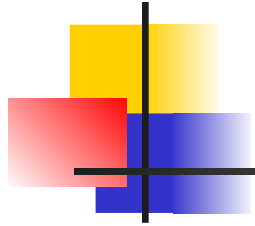


**Unlock clamp  
ring**

**Turn thimble to  
good fit at object**

- Cradle the micrometer in the palm of your hand, depending on the size of the micrometer, put your third or fourth finger through the frame.
- Ensure the clamp ring is unlocked and turn the micrometer thimble until the micrometer will fit around the object to be measured.

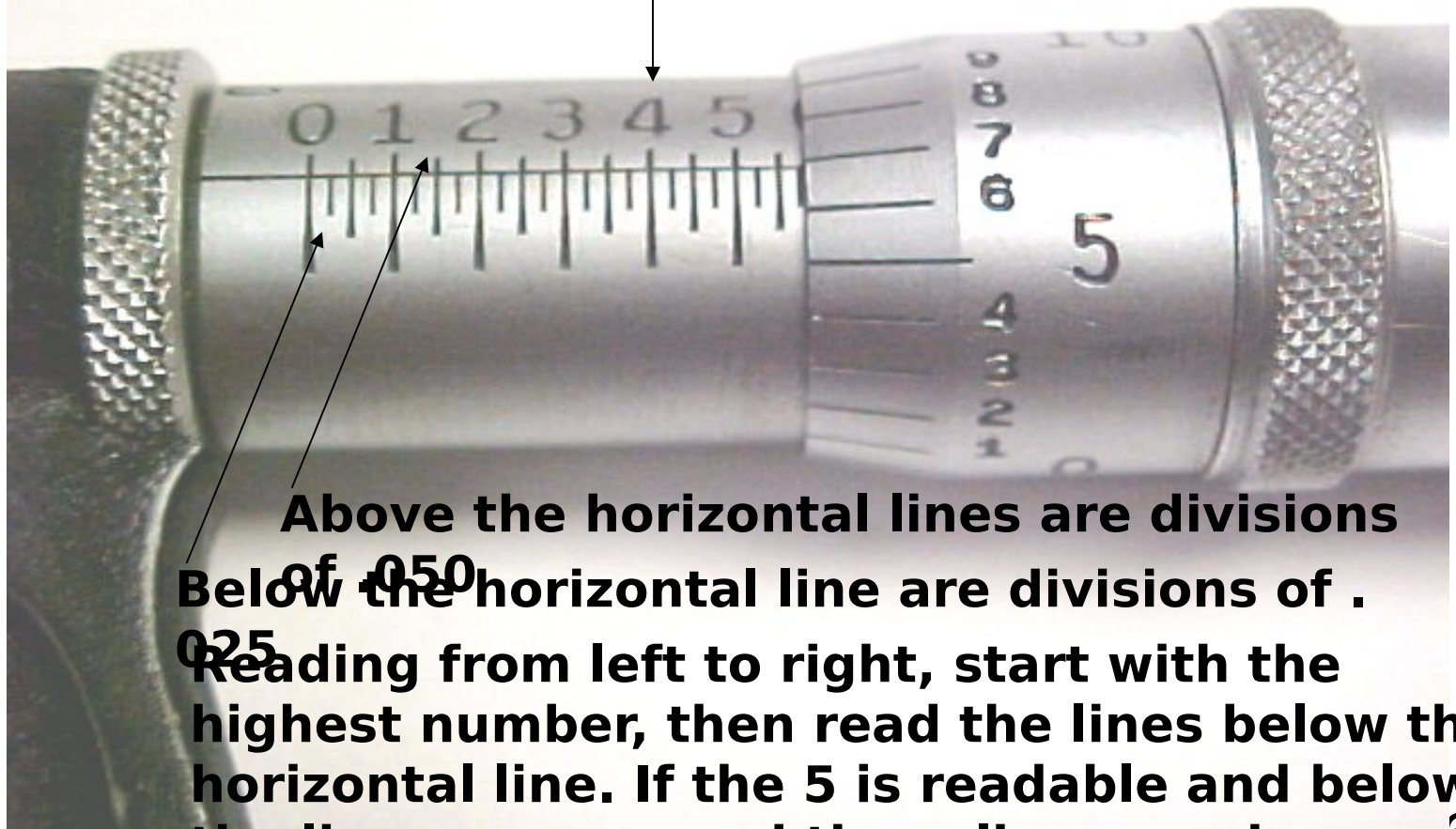




- Adjust the thimble until the anvil and spindle are in contact with the surface of the object. Then using the ratchet stop to make the final adjustment. Once the micrometer starts to ratchet, stop and set the clamp ring.

# Take your reading from the horizontal scale on the sleeve

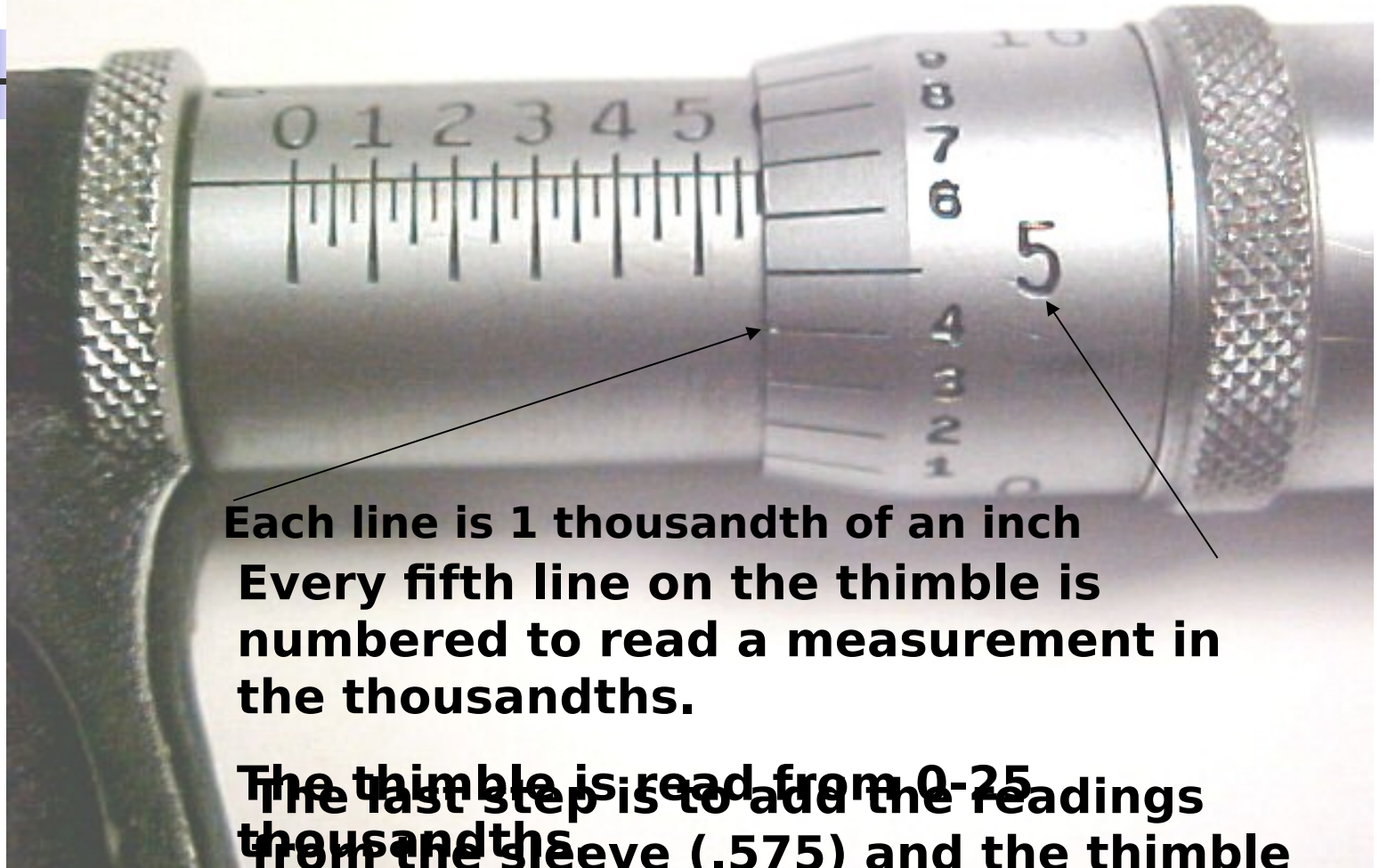
**Read the scale from left to right  
Numbers stand for hundreds**



**Above the horizontal lines are divisions  
of .050  
Below the horizontal line are divisions of .**

**Reading from left to right, start with the  
highest number, then read the lines below the  
horizontal line. If the 5 is readable and below  
the line you can read three lines you have 46**

**The beveled edge on the thimble is read next**



**Each line is 1 thousandth of an inch  
Every fifth line on the thimble is  
numbered to read a measurement in  
the thousandths.**

**The thimble is read from 0-25  
The last step is to add the readings  
from the sleeve (.575) and the thimble  
(.007) together. Your final reading is .  
582**

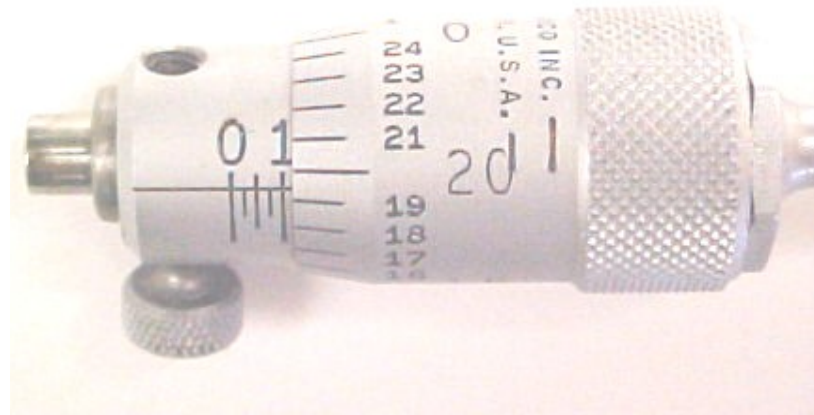


# Practical Application

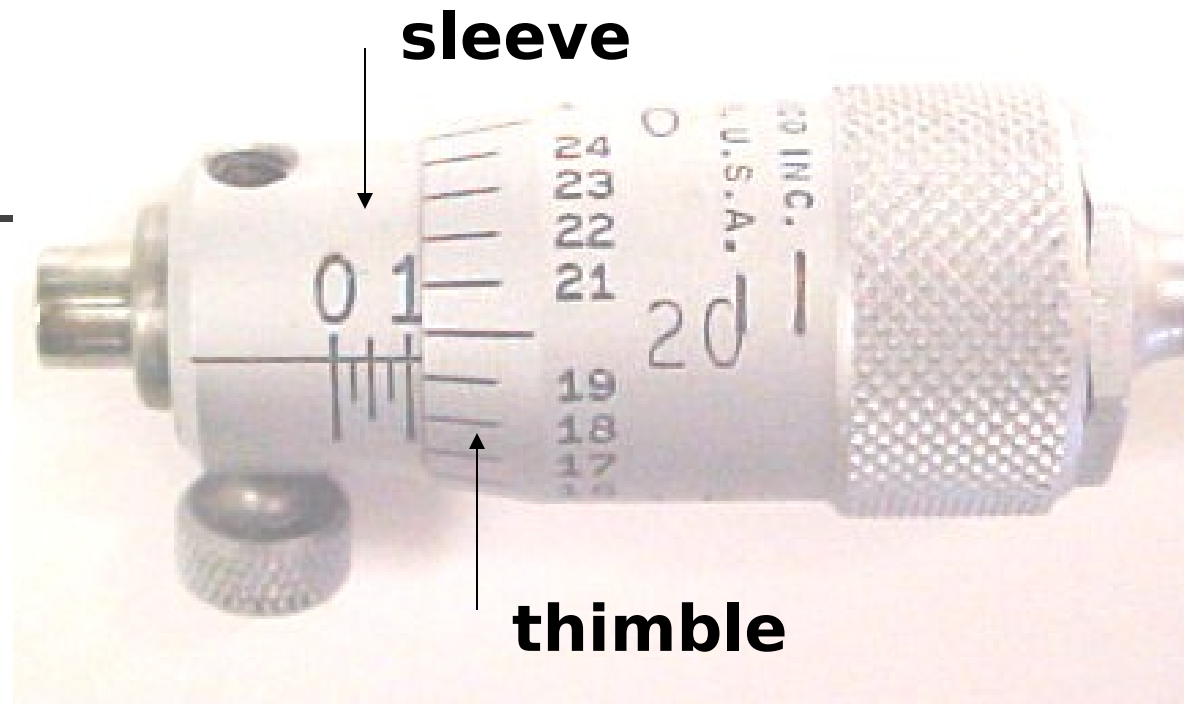
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- Do your own work.
- If you don't know don't ask the student next to you. Maybe he doesn't know either.
- Ask the instructor for help.

# *Inside Micrometers*



- As the name suggest, the inside micrometer is capable of measuring distance between two inside surfaces.
- It has the same micrometer head as a outside micrometer and is read in the same manner.



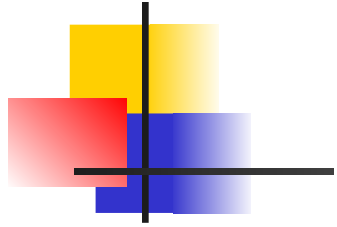
- The sleeve and thimble are read like the outside micrometer.
- It is placed inside the object to be measured and is held by a handle.

# *Hole and Telescopic gauges*



- Used to determine hole sizes or check a hole for taper or out of roundness. The tool itself only fixes the distance between the two surfaces.
- A micrometer is needed to measure the distance.





- Hole gauges are used to measure openings  $\frac{1}{2}$  in. diameter, whereas telescopic gauges will measure up to 6 inches in diameter.
- Each gauge has the ability to measure over a fixed difference. A hole gauge from .300 to .400 and a telescopic gauge from .700 to 1.250 in.

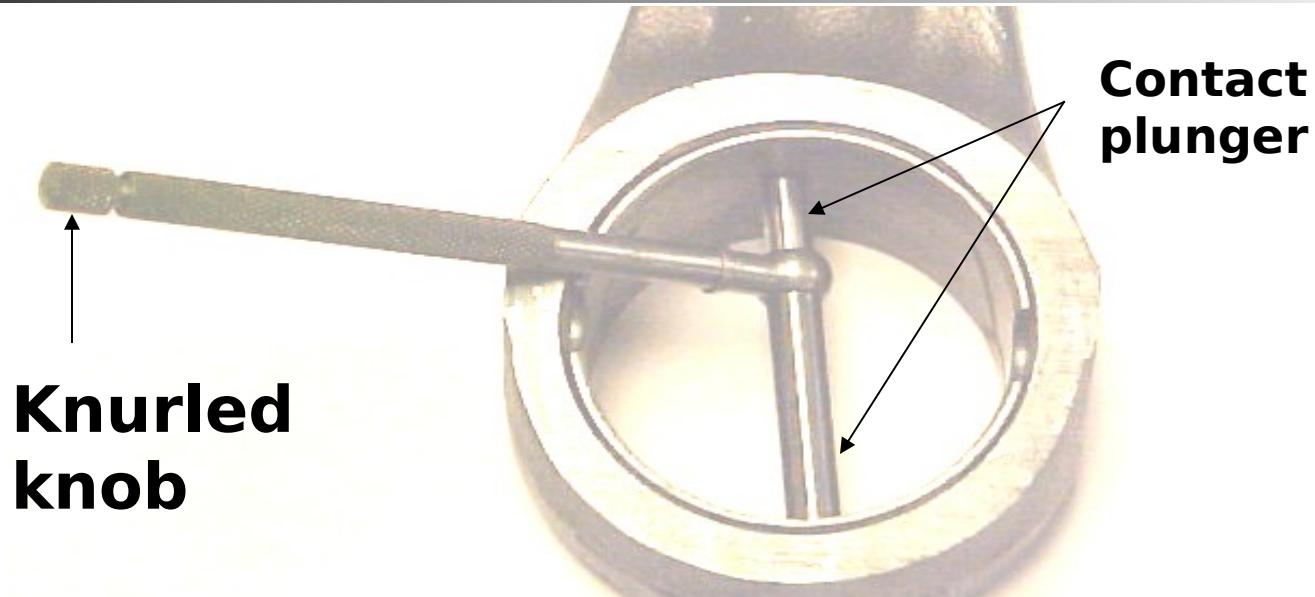


# Measuring with hole gauge

- When measuring with a hole gauge, insert the gauge into the hole and adjust the split ball by means of the knurled knob so that the two sides of the split ball contact the surface lightly.



# Measuring with a Telescopic Gauge



- With the telescopic gauge, the contact plunger expands to the hole size. When you feel the plunger touch the side of the hole, lock the knurled knob. Withdraw the gauge and, with a micrometer, measure the distance across the two contact points.



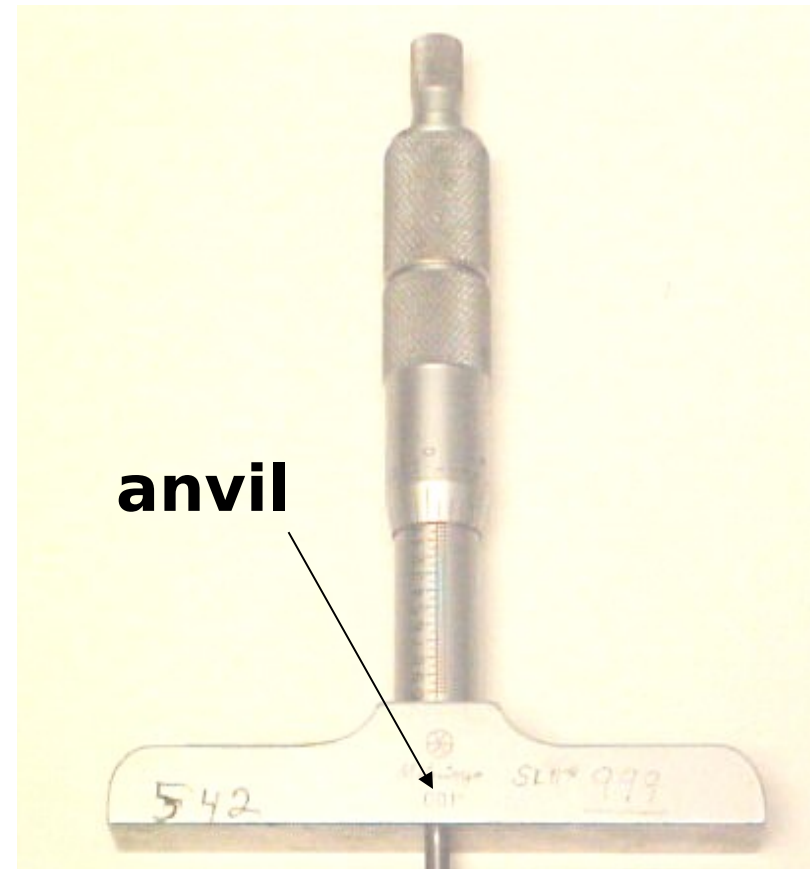
# Remember

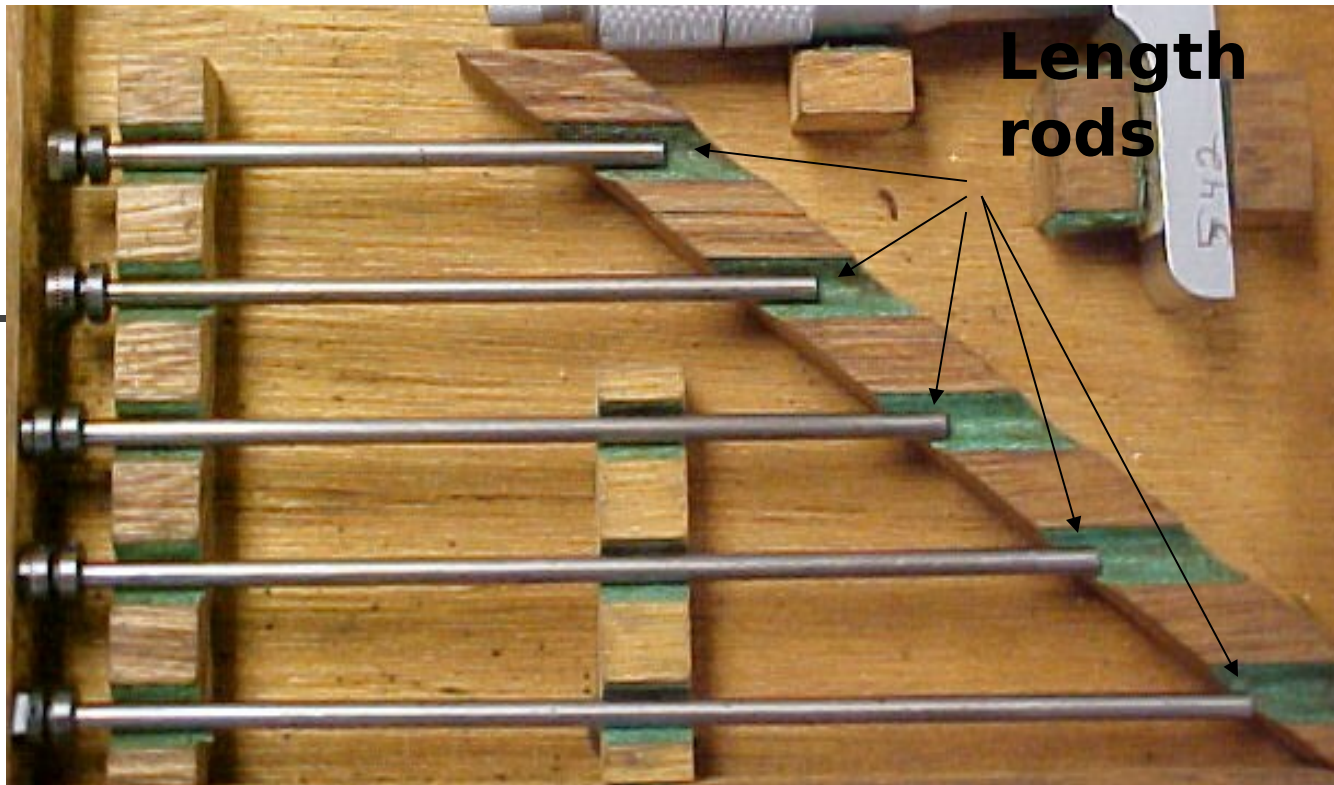
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- It is important that alignment is maintained.
- If the gauge is not properly aligned in the hole, you will get an inaccurate reading.
- A couple of thousandths could mean failure of the component being measured. It is always good practice to measure the item at the same location multiple times to ensure accuracy.

# Micrometer Depth Gauge

- Used to measure the distance between two surfaces. Notice, the micrometer head is the same as the inside or outside micrometer.
- However the anvil is moved and enlarged to a precision ground and lapped base.

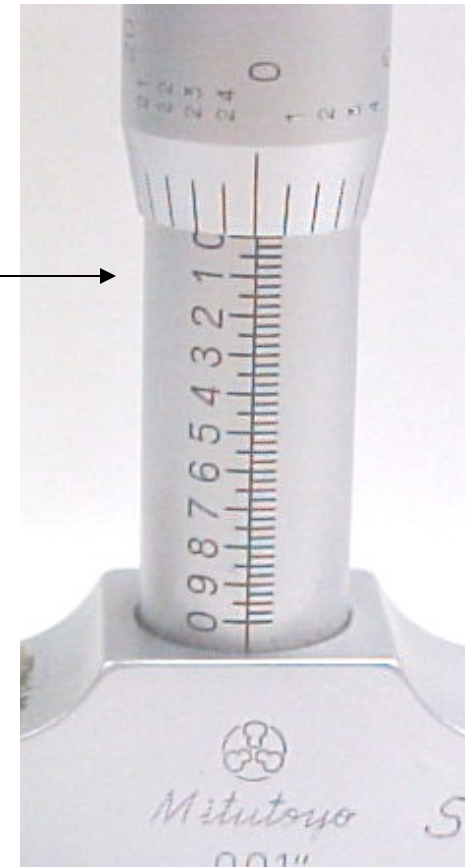




- The length or depth that you want to measure can be increased or decreased depending on the length of the rod inserted into the gauge.

# Reading the Gauge

- The scale is read top to bottom.
- When reading the scale, you are covering the markings you want to read on the sleeve. →
- Use two fingers to hold the base in place. This allows you to feel when the rod contacts the measuring surface.



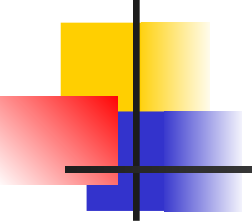


# Things to remember when using Micrometers

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- Use the gauge stock to check the micrometer for accuracy. Check the cal due date.
- All measured surfaces should be clean and free of oil or dirt.
- Balance the micrometer in your hand and hold it parallel to the object being measured.
- Do not force the spindle against the object being measured, it should slide through with little or no resistance.





# Things to remember when using Micrometers

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- Use the ratchet stop to ensure proper force. Move the object back and forth between the anvil and spindle when making the final ratchet stop adjustment.
- Proper alignment is necessary. Without it you will receive inaccurate readings. A thousandth of an inch could cause damage to the item being measured.





# Practical application

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- Measure the parts on the tables and record your readings.
- This is an individual effort.
- Measure where the items are marked.
- If you have any questions on how to perform the measurements, ASK the INSTRUCTOR!



Take a 10 minute break

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# STE/ICE-R

- A versatile testing system that rapidly performs all essential test and measurements to determine overall condition of vehicles or other equipment.





# STE/ICE-R

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- Since the STE/ICE-r is reprogrammable it can also perform special test on vehicles and equipment systems.
- Most equipment have DCA ( Diagnostic Connector Assembly) test ports and transducers wired to the vehicle wiring harness. If they are not equipped, the STE/ICE-r has transducers, power cords, fittings and current probes.

# Major items of the STE/ICE-R and their uses.

- VTM is used to test vehicle/equipment components.
- Power switch is push on/ pull off that controls D.C. power to the VTM. The VTM can operate off of 12/24 volt battery system.
- Test selection switches are used to select the actual test to be performed



# Major items of the STE/ICE-R and their uses.

- Test Button.
- Depressing and holding the test button down initiates an offset test, cal appears in the window which tells you the VTM is ready to perform that test selected by the select switches. Depressing and releasing the the button causes the test measurement to be taken.



# Major items of the STE/ICE-R and their uses.

- Readout display will show different types of readouts during testing up to a maximum of four characters.
- There are three types of readouts.
  - Status readouts
  - Numerical readouts
  - Error readout



# Major items of the STE/ICE-R and their uses.

- Transit case which is a fitted carrying case used to transport all items of the STE/ICE-R and its components.
- Cable assemblies used to supply operating power and test data to the VTM. Cable assemblies are referred to by the cable number and by name that tells how the cable is used.





# Major items of the STE/ICE-R and their uses.

- Transducer kit that contains a cover, transducers, adapters, and a current probe. Used to connect the VTM to the vehicle/equipment for testing in the TK mode.





# Major items of the STE/ICE-R and their uses.

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- Technical manual that describes the operation and maintenance of the STE/ICE-R system. It also contains detailed operating procedures for general and special measurements.
- Test probe kit that contains a variety of clips and probes which can be attached to the test probe cable W2. These clips and probes allow the user to make different types of measurements with greater ease.



# STE/ICE-R measurement capabilities

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- Has three major measurement capabilities:
  - General measurements
  - Special test
  - Diagnostic Connector Assembly (DCA) test



# General Measurements

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- STE/ICE-R can be used to make standard voltage, current, resistance, pressure and speed measurements without the need for specific vehicle or equipment information. In making general measurements, the VTM receives power through the power cable W5 or DCA cable W1. Test data may be received through various test probe cables and transducers.



# Special Test

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STE/ICE-R can be used to test specific vehicles in the Marine Corps inventory. When a recognized vehicle identification (VID) number is entered in the VTM, the STE/ICE-R will automatically use information stored in its memory together with the test data received to give a result. The VTM is connected in the same manner as previously stated. Test data may be received through various test probe cables and transducers. In addition, some special test can be used without the VID number to make measurements on any vehicle/equipment.



# DCA Test

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- If the vehicle is equipped to be tested has permanently mounted DCA, the VTM can receive both its power and test data through DCA cable W1. Wires from the DCA connect to the test points and the equipment or power source. Additional transducers can be used at the same time for test points not connected to the DCA.



# Setup Procedures, no DCA connection.

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- Connect power cable to VTM
  - Pull off power switch on the VTM.
  - Connect P1 of power cable W5 to 01 on VTM.
  - Connect the red clip of W5 to positive terminal of 24 volt battery system.
  - Connect the black clip lead of W5 to negative terminal of the same battery source.



# Setup Procedures, no DCA connection.

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- Power up
  - Push on the power switch on the VTM
  - Verify the display indicates .8.8.8.8 for two seconds, then changes to .-.-.-.-.

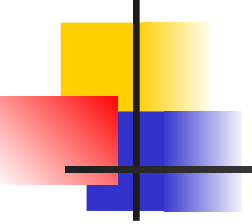




# Setup Procedures, no DCA connection.

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- Run confidence test- provides overall check of the VTM to ensure it is functioning properly.
  - Dial 66 into the test selector and press test.
  - Wait for the readout to display.0.0.6.6
  - Dial 99 into the test selector and press test.
  - The display will follow through different readings. Wait for pass to be displayed.
  - Proceed with testing equipment by connecting transducers to the machine and follow instructions from the manual on the test you are about to perform.



# Setup for Equipment with DCA connection.

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- In the DCA mode the VTM receives its power from the W1 cable connected to the equipment.
- **Do not connect** the VTM to the DCA while the VTM power switch is on, damage to the connectors may occur.
  - Pull off the VTM power switch.
  - Connect the VTM to diagnostic connector



# Setup Procedures, no DCA connection.

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- Attach connector P1 of cable W1 to J1 DCA/PWR of VTM. Align the white mark on the connector P1 with the large slot in the keyway of J1. Twist lock ring until it clicks.
- Attach connector P2 of cable W1 to equipment Diagnostic connector.
- Push the VTM power switch. The STE/ICE-R should now go through the same display sequence as before in the previous setup.



# Practical Application.

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- Have students identify STE/ICE-R components.
- Hook up test equipment to the DCA connection and go through setup procedures.
- Hook up test equipment using TK transducers and go through setup procedures.
- Perform general test on equipment.



# Questions?

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Take a 10 minute break.

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# Digital Multimeter

- A small hand held meter that allows for multiple, wide range of test
- It can be used to test for:
  - Voltage, resistance, and amperage on individual items.
  - Used to test wiring for continuity, shorts and grounds



# Digital Multimeter

- Powered by removable 9 volt battery and is equipped with a fuse to prevent damage to the multimeter from excessive voltage or amperage.





# Digital Multimeter

- Equipped with removable test leads, one black and one red. May also include self closing clips that attach to the ends of the leads to allow hands free testing or adjustment of the component while it is being tested.



# Control features of the Multimeter

- Power switch. Allows the meter to be turned off/on. Some models incorporate a feature that will automatically shut off the meter if it is not used for a period of time. Generally, the time limit is 10 minutes.



# Control features of the Multimeter

- Range Selector. This feature is either a dial in the center of the meter or push/pull buttons on the side that allows the mechanic to select the work range he/she desires.
- AC/Dc Selector. Allows for measurements in alternating current or direct current.



# Control features of the Multimeter

- Probe Position Connectors. Allows the mechanic to insert the end of the test probes into the multimeter for test being performed. Certain slots are equipped with fuses to prevent damage to the meter.



# Selecting the Ranges

- Used to test for \_\_\_\_\_  
Ohm's/resistance.
- Voltage DC
- Voltage AC





# Using the Multimeter

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- The meter should be used for finding voltage, amperage or resistance. Unlike the test light that only shows if some amount of voltage is present. The meter will tell you how much of what you are measuring is present. By using the multimeter, you are not damaging the insulator of the component you are measuring unlike the test light.



# Using the Multimeter

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- An advantage of the multimeter is that when measuring current, amperage or resistance the possibility of overloading a circuit is greatly reduced. This is because the meter is only measuring and not trying to provide a current path of flow.



# Practical Application

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- Test components for Ohm's, Continuity, and Resistance.
- Record your readings.
- Identify serviceable or unserviceable components.
- Turn off multimeters when completed
- This is a individual effort.



# Caterpillar Multi-Tachometer

- A digital tachometer that contains a microcomputer that is programmed by the mechanic.
- Can be used as a remote readout photo-tachometer or it can be used with a magnetic speed pickup or tachometer generator.





# Caterpillar Multi-Tachometer

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- There is also an inductive fuel line pick-up that converts the pulse signal of a fuel line pressure into an RPM readout.
- To setup and operate, refer to the special instruction manual supplied with the multi-tachometer for various applications.



# Practical Application

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- Divide into groups of four.
- Setup tachometers to read magnetic and fuel line pickup.

# Engine Pressure Gauge Group

- An engine pressure gauge group can be used to check or test the performance of diesel engines. The pressure gauge group allows the mechanic to perform multiple test at the same time and observe the readings all at once. The test performed with the pressure group can also be performed with the STE/ICE-R but require the transducers to be relocated for each test.



# Gauges that Measure different types of pressure

- Gauge measures in inches of water that is capable of measuring vacuum or pressure.
- Measures in inches of mercury from two different locations. Has an input selector lever that allows the mechanic to observe each test location separately without disconnecting the hose.



# Gauges that Measure different types of pressure

- Three gauges allow liquid pressure test in the range of 0-60 psi.
- One gauge allows liquid pressure test in the range of 0-144 psi.
- Set also contains clear plastic tubing and an accessory kit containing fittings to allow the gauge set to be connected to the equipment being tested.





# Questions?

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# Take a 10 minute break

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# Hydraulic Flow Tester

- An inline hydraulic flow tester is compact, self contained, portable instrument for testing systems in the shop or field.
- When performing flow test always refer to the equipment maintenance manual and the flow test operation manual to ensure the test equipment is properly set up.



# Operating controls of the OTC flow tester

- On/off switch- is a push/pull type. Pull the switch and the unit is on, push and the unit is off.
- Fuse- protects the meter from incorrect hookup when using auxiliary power.
- Flow/RPM switch- set to flow gives you a flow reading, set to RPM gives you a RPM reading.

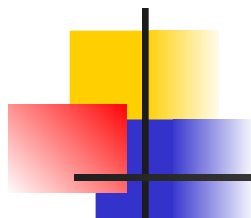


# Operating controls of the OTC flow tester

- Hi/Low range switch- is a maintained switch and will stay in the mode it is switched to. Hi and low range positions for the unit are used to measure flow at different GPM's. Refer to the tester manual for specific scale settings.

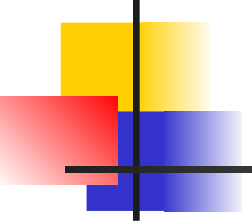


# Operating controls of the OTC flow tester



- Temp Switch- is a momentary position switch. When the toggle is depressed, meter reading of the flow will be cancelled and the temperature mode will take over. Temperature is read in both degrees and centigrade on the temp scale. Upon release of the toggle switch cancels the temp reading, and the meter returns to whatever mode it was in previously.





# Operating controls of the OTC flow tester

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- On/Off light switch-two position toggle switch.
- Input Jack- The electrical cable of the phototach attaches to the tester at this point.
- RPM Selector- a multi-position switch, allows selection of six different tachometer readings.
- Aux Power jack- provided for aux power input
- Cal jack- provided for calibration instrument input.



# Operating controls of the OTC flow tester

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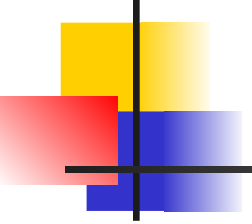
- Meter- Gives flow and temperature readings depending on the switch mode used. It is important to remember in an extremely dry environment, a static charge may build up on the meter face; this charge will cause an incorrect meter reading. To detect this condition, touch the meter face on either side of the needle; if the needle changes position, discharge the meter face by wiping with a damp cloth.



# Operating controls of the OTC flow tester

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- Pressure Control Valve. Regulates system pressure by restricting the flow to varying degrees to develop backpressure in the system. To increase pressure, turn the control valve handle clockwise; to reduce pressure, turn control valve handle counterclockwise. The control valve will maintain pressure setting during and after change in flow.

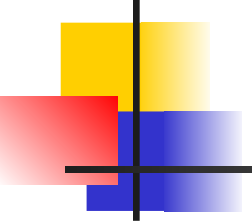


# Operating controls of the OTC flow tester

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- Pressure Gauges. Pressure readings are taken from the high pressure and low pressure gauges on the flow block. The high pressure gauge (0-6000 psi, 0-410 bar) is to the left of the gauge block, and the low pressure gauge (0-600 psi, 0-41 bar) is to the right of the gauge block. As pressure increases the low pressure gauge will give readings up to 500 psi (35 bar) and then cut out, allowing higher than 500 psi readings to be taken from the high pressure gauge.





# Operating controls of the OTC flow tester

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- Gauge Snubber Knob. A gauge snubber knob is located at the lower left corner of the gauge block. To dampen the pulsation in the gauge needles, turn the snubber knob clockwise at a low pressure setting.



# Operating controls of the OTC flow tester

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- Overload Protection Safety Disk- located at the rear of the flow tester protects the flow tester from extreme pressure. If pressure exceeds the hydraulic pressure listed in the operations manual, the disk ruptures, relieving oil and reducing pressure before damage may occur to the flow tester.



# Operating the Accessory Photo Tachometer.

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- The phototach must be used with an auxiliary power source as the phototach requires more power than the internal batteries can supply. To operate the phototach you must:
  - Apply a light reflective material such as a small piece of white tape to a rotating object from which the reading will be taken.



# Operating the Accessory Photo Tachometer.

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- Connect the electrical cable from the phototach assembly to the input jack on the hydraulic tester panel and set the Flow/rpm toggle switch to RPM mode. Set the on/off switch to the on position. This turns the phototach pickup bulb on.



# Operating the Accessory Photo Tachometer.

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- Hold the phototach pickup within 12" and perpendicular to the reflective material on the rotating object. The objects RPM's are read on the hydraulic tester panel's high and low flow scale, depending on the position of the high/low range selector switch. The high/low switch is located below the RPM switch on the panel.

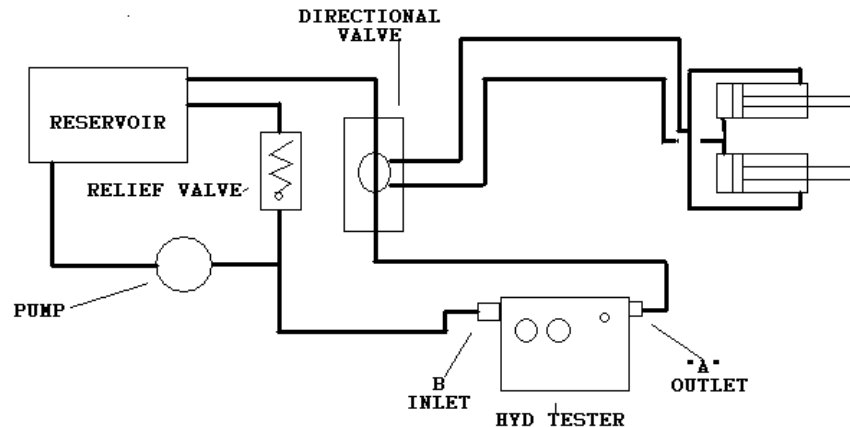


# Typical Flow Meter Test

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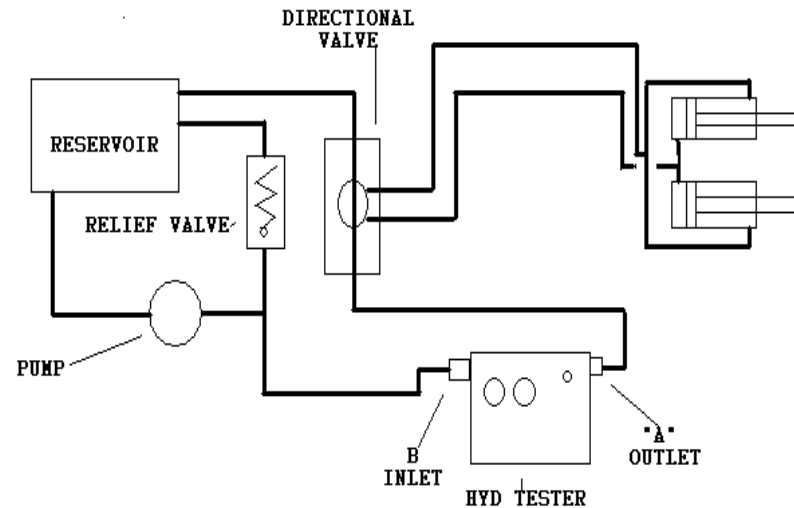
- Pump Test
- Relief Valve Test
- Directional Valve Test
- “TEE” connection Test

# Pump Test



- This test is accomplished by disconnecting the hydraulic lines between the pump and relief valve. The flow tester is then connected between the pump and the relief valve.

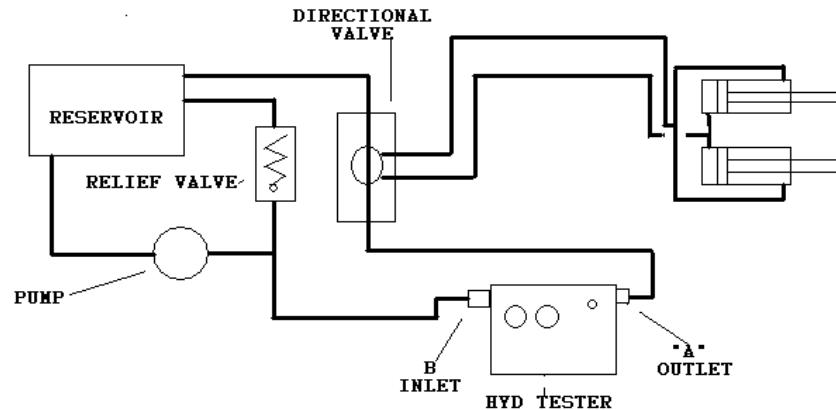
# Pump Test



- Once this is done, the mechanic should follow the equipment technical manual and the flow tester operation manual to perform the rest of the test procedures. This must be done in this manner because every machines pump operations vary in the amount of fluid flow it generates.

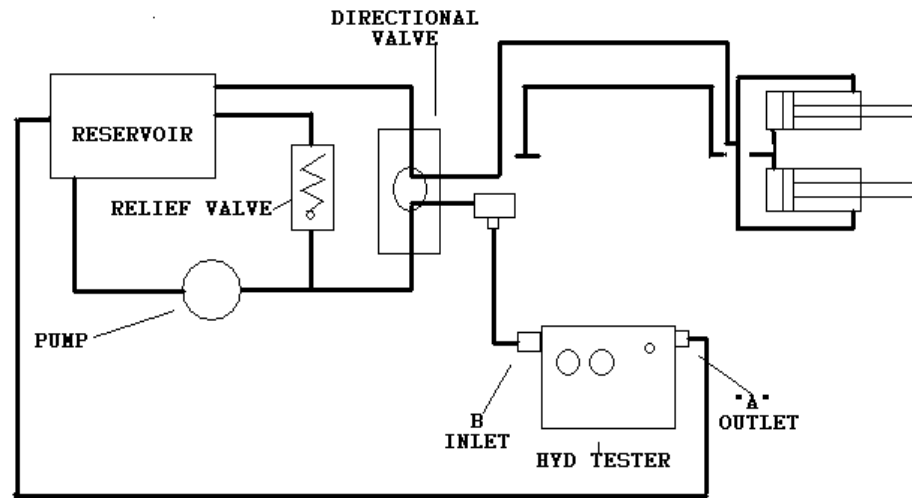


# Relief Valve Test



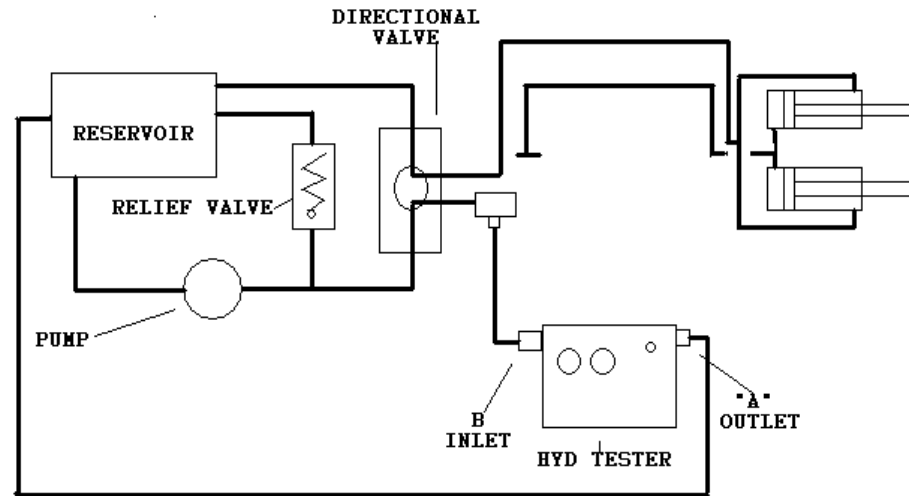
- This test diagnoses the setting of the relief valve. The flow tester is placed after the relief valve and before the directional control valve. Once this is done, the mechanic again refers to the equipment technical manual and the flow tester operational manual to perform the rest of this test.

# Directional Valve Test



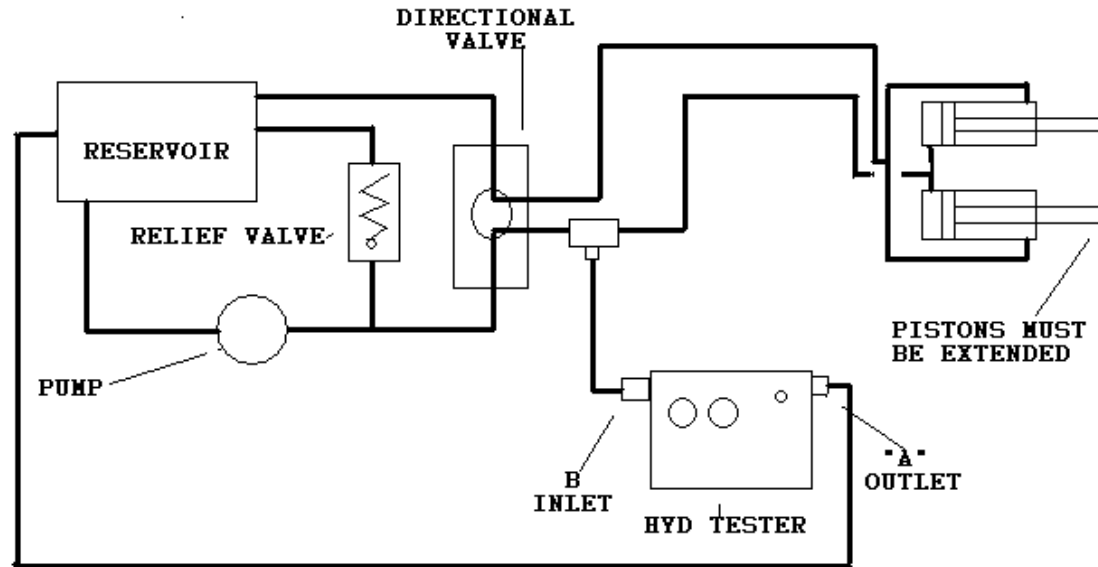
- This test diagnoses the directional control valve. The flow tester is placed after the directional control valve and the outlet line from the tester is sent back to the hydraulic reservoir.

# Directional Valve Test



- The disconnected line to cylinder is capped to prohibit oil from escaping during the test. Again the mechanic will refer to the equipment technical manual and the flow tester operation manual to perform the test properly.

# Testing with TEE Connection



- This test method is for testing overall circuit performance. The hydraulic tester is connected between the directional control valve and the cylinder with a “TEE” fitting and a line is ran back to hydraulic reservoir for discharge. To properly perform this test the mechanic would refer to the equipment technical manual and the hydraulic flow tester operation manual.



# Important

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- It is very important that the mechanic refer to the equipment technical manual to ensure that he is performing the test properly. Incorrect test procedures and the wrong oil temperature will give a false reading, thereby causing a false diagnoses of an apparent problem.



# Caterpillar Transmission Hydraulic Test Set

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- A multi-gauge test set that enables the mechanic to perform up to eight different test on all power shift transmissions as well as other hydraulic systems at one time. The mechanic is also able to take a mechanical tachometer reading from the engine to determine engine speed for the transmission and hydraulic test being performed.

# Caterpillar Transmission Hydraulic Test Set





# Measuring transmission and hydraulic pressure

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- The test gauge set is equipped to test hydraulic pressure in the ranges of 0 to 5000 psi.
  - Select a gauge that exceed the pressure being tested. This is normally the gauge that exceeds the maximum pressure by 25 percent.
  - If the equipment is equipped with ready test ports that are compatible to the test gauge all that is required is that the test hoses are properly connected to the equipment and test set.





# Measuring transmission and hydraulic pressure

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- If the equipment is not equipped with ready test ports, the mechanic may use the adapters that are included in the accessory tray to connect the equipment to the test set.
- It is important to remember to make sure that the proper adapter is used. The mechanic does not want to have leaks at the fittings or strip the threads at the test location. Any leaks result in a bleed off of system pressure and will result in a false reading.

# Test Gauges



- The gauge set is equipped with: One 0- 60 PSI gauge, One 0-100 PSI gauge, One 0-200 PSI gauge, Three 0-600 PSI gauge, One 0-2000 PSI gauge, One 0-5000 PSI gauge and one mechanical tachometer that is capable of reading 400 to 4800 RPM's.

# Accessory Tray

- Contains an assortment of different nipples, elbows, and adapters. It also contains a tachometer drive assembly and eight hose assemblies.





# Practical Application

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- Set up Transmission hydraulic test set
- Perform transmission test
- Cleanup after test

# Hydraulic Multi-Gauge

- Allows the mechanic to test and adjust a specific relief valve or pressure block.
  - Contains three gauges that automatically step up to the next pressure level when the reading gauge exceeds its maximum pressure.



# Gauges

- Contains three gauges. The first gauge on the lower left side allows pressure test of 0-30 inches of mercury in vacuum and 0-150 PSI hydraulic pressure. Once this pressure is met the gauge will step up to the gauge on the lower right side of the face and allow test of 0-600 PSI in hydraulic pressure. When the pressure is exceeded on this gauge it will step up to the top center gauge that measures from 0-5000 PSI in hydraulic pressure.





# Important

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- It is important to remember that all three gauges will read at the same time. You must read the gauge shows the highest pressure present. For example, if you are getting a reading of 100 PSI on the gauges, the lower left gauge will give the most accurate reading because the scale is measured in smaller increments. The same goes for if you are measuring a working pressure of 3500 PSI, the bottom two gauges will read to the max of there capabilities but you would read the top center gauge.



# Practical Application

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- Setup multi-gauge
- Perform multi-gauge test.
- Cleanup



# Engine Valve Spring Tester

- This item of TMDE is used to diagnose engine valve spring malfunctions. Over time a valve spring may weaken or shorten depending on use and temperature extremes. The only way to test a valve spring is to accurately measure its height and the amount of weight it takes to compress the spring.

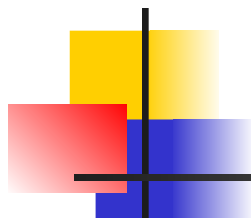


# Measuring Valve Spring Height

- The valve spring is placed on the tester bed and the foot is lowered till the foot contacts the top of the valve spring.
- The height of the valve spring is read on the scale to the right of the spring using either the inch or metric scale.



# Measuring Valve Spring Tension



- The valve spring is placed on the tester bed and the foot is lowered till the foot contacts the top of the valve spring.
- Next, referring to the technical manual, the mechanic will set the red adjustment needle to the desired foot-pounds or kilos as specified by the manufacturer.
- In reference to the technical manual, the valve spring is compressed to the appropriate height and the reading is taken from the face of the large dial gauge.





# Questions?

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